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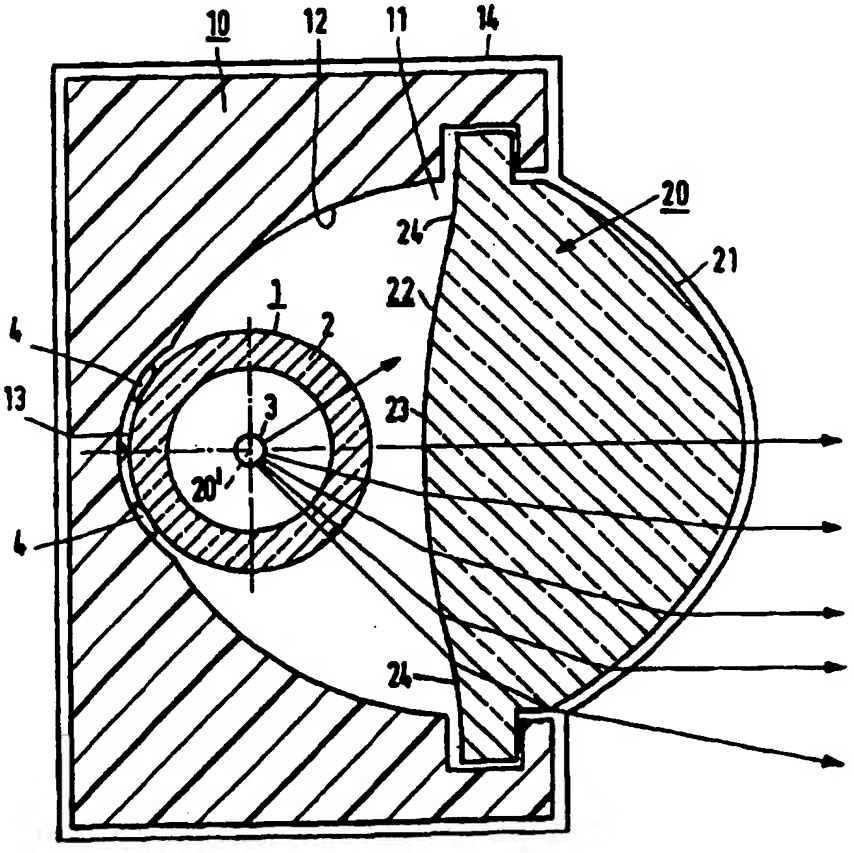
(54) Title: SIGNALLING SYSTEM

(57) Abstract

The signalling system contains a low-pressure rare gas discharge lamp (1) having a tubular lamp vessel (2) provided with electrodes (3). The lamp is accommodated in a housing (10) having a light-emission window (11) and light-reflecting means (12). The housing has a light-reflecting inner surface to constitute the light-reflecting means and an elongate converging lens, closing the light-emission window. The housing may have a niche (13) in which the lamp is partially recessed countersunk and in which the lamp may be secured by an adhesive (4). The system is of a simple construction and allows for meeting the requirements set to braking lights, even when having very small dimensions.



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Signalling system.

The invention relates to a signalling system comprising:

a low-pressure rare gas discharge lamp with a tubular lamp vessel whose end portions each accommodate a respective electrode, and

a housing provided with a light emission window and with light-reflecting means, in which housing the low-pressure rare gas discharge lamp is accommodated.

Such a signalling system is known from US-A 4,682,146.

The known system is suitable for use as a brake light, for example placed in a comparatively high position, on motor vehicles. Alternatively it may serve, for example, as a tail light or for indicating intended changes in direction.

The system has an electrically conductive reflector in the housing. It may be applied against or recessed in the rear of a motor vehicle, or may be mounted inside such a vehicle, for example behind the rear window. A disadvantage of the known system here is that it is comparatively voluminous. It is stated that its dimensions transverse to the tubular lamp vessel are 2 x 2 inch^2 (approximately 5 x 5 cm^2). Owing to its comparatively great height, the system when mounted behind a rear window blocks out comparatively much of the view through the rearview mirror. When mounted to the rear of a vehicle, the system renders it desirable to make windows in the car bodywork for countersinking the system therein because of its comparatively great depth.

Another disadvantage of the known system is that two parallel dark stripes are visible in the light emission window, formed by the lamp vessel wall on either side of the discharge of the neon/argon-filled lamp. Accordingly, the system does not have a homogeneous brightness during operation.

A low-pressure rare gas discharge lamp is known from EP-A 0 562 679 (PHN 14.189) which is suitable for use in the signalling system. The lamp has tubular electrodes and a filling of, for example, neon, neon/helium, or xenon, possibly xenon with a coating of fluorescent material such as, for example, willemite. The lamp may have an

internal diameter of, for example, 1.5 to 7 mm, for example 3.5 ± 1.5 mm.

In EP Application 94 202 708.7 (PHN 15.023) of earlier date, such a low-pressure rare gas discharge lamp is described in which a tube coated with electron emitter and open at both ends is present in front of each of the tubular electrodes, which tube is connected to the associated electrode by electrically conducting means. Said means therein form a heat resistance between the tube and the electrode.

It is an object of the invention to provide a signalling system of the kind described in the opening paragraph which is of a simple construction, which renders possible a slimmer design, and which supplies a homogeneous brightness, luminance, during operation.

According to the invention, this object is achieved in that the housing has an inner surface which is reflecting so as to form light-reflecting means, and an elongate converging lens having a focal line, which lens coincides with the lamp and closes off the light emission window.

The light-reflecting means are integral with the housing. It is true that a comparatively high reflectivity, a low absorption, is useful for sending as much light hitting the reflecting means as possible to the light emission window, but it was found for lamps without fluorescent walls that a high mirroring power is not necessary. It is possible with the system according to the invention having a housing of only a few centimeters high, for example 2 to 3 cm, to improve on the brightness which is realised with the use of conventional systems comprising incandescent lamps.

It is favourable when the housing has an elongate niche, in which the lamp is partly recessed, opposite the light emission window. The light emission window, and thus the housing, may then have an even smaller height. It is advantageous when the niche and the lamp vessel have substantially the same curvature. Radiation hitting the niche wall is then substantially perpendicularly incident on this wall and is reflected back to the lamp for the major part along the same path. In addition, this embodiment offers the possibility of fastening the lamp in said niche with an adhesive. A correct position of the lamp relative to the lens is easy to realise in this way. Alternatively, however, the lamp may be held in the housing, for example, in clamps.

The inner surface of the housing may be mirroring, inside the niche or entirely, for example in that a metal film or an interference film has been vapour-deposited.

This is favourable when the lamp radiates light from its surface only, such as is the case when the lamp vessel is provided with a fluorescent material, for example is coated with a fluorescent powder, for example a lamp with a xenon filling and zinc silicate activated by manganese (willemite). If the lamp radiates from its entire volume, as is the case with a non-fluorescent lamp having a filling of, for example, xenon, neon, or neon/argon, a favourable embodiment of the housing has a diffusely reflecting inner surface, for example obtained by means of a paint, for example a white or grey paint or a paint having the colour of the generated light or of the surroundings of the housing. Alternatively, the housing may consist of a synthetic resin which is coloured through-and-through. Alternatively again, the housing may be of metal, for example in the case of an AC-operated lamp.

It was found that the shape of the reflecting inner surface is not particularly critical in a diffusely reflecting version thereof. The surface may be circularly or parabolically curved, for example remote from the light emission window in cross-section, and may widen linearly near the light emission window in a direction towards said window. Alternatively, however, it may be entirely parabolically curved, possibly away from a niche. This shape is also favourable for a mirroring reflecting surface.

It is advantageous when the lamp vessel has a small diameter, for example an inner diameter of 2.5 $\pm$ 0.5 mm. The lamp then has a higher luminance than if the internal diameter were greater, which further increases the luminous flux in the beam generated by the system.

In a favourable embodiment, the lens is parabolically curved in cross-sections at its outer surface. The inner surface may be, for example, convexly circularly curved in said cross-sections. It is favourable for a low-reflectivity on the inner surface of the lens when the lens has fringe zones on its inner surface on either side of a central, convex circularly curved zone, which fringe zones together lie in a flat plane or which, more in particular, are concave with a comparatively small circular curvature, a comparatively great radius of curvature. These fringe zones also contribute to spreading of the light in the beam in directions which enclose a small angle of a few degrees with the centreline of the beam.

The lens may be made of glass or synthetic resin and may be colourless, or have the colour of the light to be radiated, or have the colour of its surroundings, for example the colour of the bodywork of a motor vehicle.

Embodiments of the signalling system according to the invention are shown in the drawing, in which

Fig. 1 is a perspective view of a first embodiment;

Fig. 2 is a cross-section through Fig. 1 on an enlarged scale; and

Fig. 3 is a cross-section of an alternative embodiment.

In Figs. 1 and 2, the signalling system comprises a low-pressure rare gas discharge lamp 1 with a tubular lamp vessel 2 whose end portions each accommodate a respective electrode 3. The lamp is held in a housing 10 provided with a light emission window 11 and light-reflecting means 12.

The housing has an inner surface which is reflecting so as to form the light-reflecting means 12. The housing further has an elongate converging lens 20 with a focal line 20' which coincides with the lamp 1. The lens closes off the light emission window 11.

In the embodiment shown, the housing is made of white polymethyl methacrylate, the lens of transparent polymethyl methacrylate, so that the inner surface of the housing 1 is diffusely reflecting. In a modification, the housing is also made of transparent polymethyl methacrylate which is painted internally white and externally a dull black. The housing is closed off with a plastic cap 14 at either end.

The housing 10 has an elongate niche 13, in which the lamp 1 is partly recessed, opposite the light emission window 11. The niche 13 and the lamp vessel 2 substantially have the same curvature.

The lamp 1 is fastened in the niche 13 in a few spots with an adhesive 4.

The lamp vessel 2 of the lamp shown has an internal diameter of 2.5 $\pm$ 0.5 mm, and a wall thickness of approximately 0.6 mm.

The lens 20 shown has a substantially parabolically curved outer surface 21 in cross-section. Its inner surface 22 is substantially convexly circularly curved in cross-section. The inner surface 22 of the lens has concave fringe zones 24 of comparatively small circular curvature in cross-sections on either side of a central zone 23.

The lamp has a length of approximately 40 cm and a filling of 25 mbar neon. Operated with a DC-voltage, the lamp carries a current of approximately 8 mA at

rated power.

In the embodiment shown, the outer surface of the lens is curved in accordance with $y^2 = 5.56 \times [mm^2]$, the inner surface of the central zone is convex through an angle of 27° measured from the centre of curvature, with a radius of 10 mm, and concave in the fringe zones with a radius of 6 mm. Outside the niche, the housing is curved in cross-sections in accordance with circular arcs having a radius of 5 mm. The light emission window has dimensions of 390 * 8 mm^2, so that the housing is no bigger than 420 * 11 * 10 mm^3.

A same lens 20 is used in the embodiment of Fig. 3. The housing 30 has a trapezium shape internally in cross-sections at the area of the niche 33, and adjoining thereto has a parabolic inner surface 32a, upon which its inner surface 32b widens linearly up to the light emission window 31. An identical lamp 1 is mounted therein.

The photometric properties of the system of Figs. 1 and 2 were measured and compared with the European requirements set for a central, high brake light on motor vehicles. The results are listed in Table 1.

Table 1

dir		req ≥ [cd]	syst [cd]
vert [°]	hor [°]	(ECE R7 Cat. S3a)	
10 U	10 L	8	42
10 U	0	16	44
10 U	10 R	8	42
5 U	10 L	16	65
5 U	5 L	25	65
5 U	0	25	65
5 U	5 R	25	65
5 U	10 R	16	65
0	10 L	16	77
0	5 L	25	76
0	0	25	76
0	5 R	25	76
0	10 R	16	77
5 D	10 L	16	65
5 D	5 L	25	65
5 D	0	25	65
5 D	5 R	25	65
5 D	10 R	16	65

dir: direction from lamp centre hor: horizontal

vert: vertical U: upward

D: downward L: to the left

R: to the right req: requirement

syst: system

It is apparent from Table 1 that the system easily exceeds the requirements in spite of its small height and depth. The system has an even luminance. Dark stripes are effectively counteracted.

CLAIMS:

1. A signalling system comprising:

a low-pressure rare gas discharge lamp (1) with a tubular lamp vessel (2) whose end portions each accommodate a respective electrode (3), and

a housing (10) provided with a light emission window (11) and with light-reflecting means (12), in which housing the low-pressure rare gas discharge lamp (1) is accommodated,

characterized in that the housing has an inner surface which is reflecting so as to form light-reflecting means (12), and an elongate converging lens (20) having a focal line (20') which lens coincides with the lamp (1) and closes off the light emission window (11).

2. A signalling system as claimed in Claim 1, characterized in that the housing (10) has an elongate niche (13), in which the lamp (1) is partly recessed, opposite the light emission window (11).

3. A signalling system as claimed in Claim 2, characterized in that the niche (13) and the lamp vessel (2) have substantially the same curvature.

4. A signalling system as claimed in Claim 1 or 2, characterized in that the inner surface of the housing (1) is diffusely reflecting.

5. A signalling system as claimed in Claim 1 or 2, characterized in that the lamp vessel (2) has an inner diameter of 2.5 $\pm$ 0.5 mm.

6. A signalling system as claimed in Claim 1 or 2, characterized in that the lens (20) has an outer surface (21) which is substantially parabolically curved in cross-section. 7. A signalling system as claimed in Claim 6, characterized in that the lens (20) has an inner surface (22) which is substantially curved into a convex circle in cross-section.

8. A signalling system as claimed in Claim 7, characterized in that the inner surface (22) of the lens has fringe zones (24) of a comparatively small concave circular curvature on either side of a central zone (23) in cross-sections.

9. A signalling system as claimed in Claim 2 or 3, characterized in that the lamp (1) is fastened in the niche (13) with an adhesive (4).

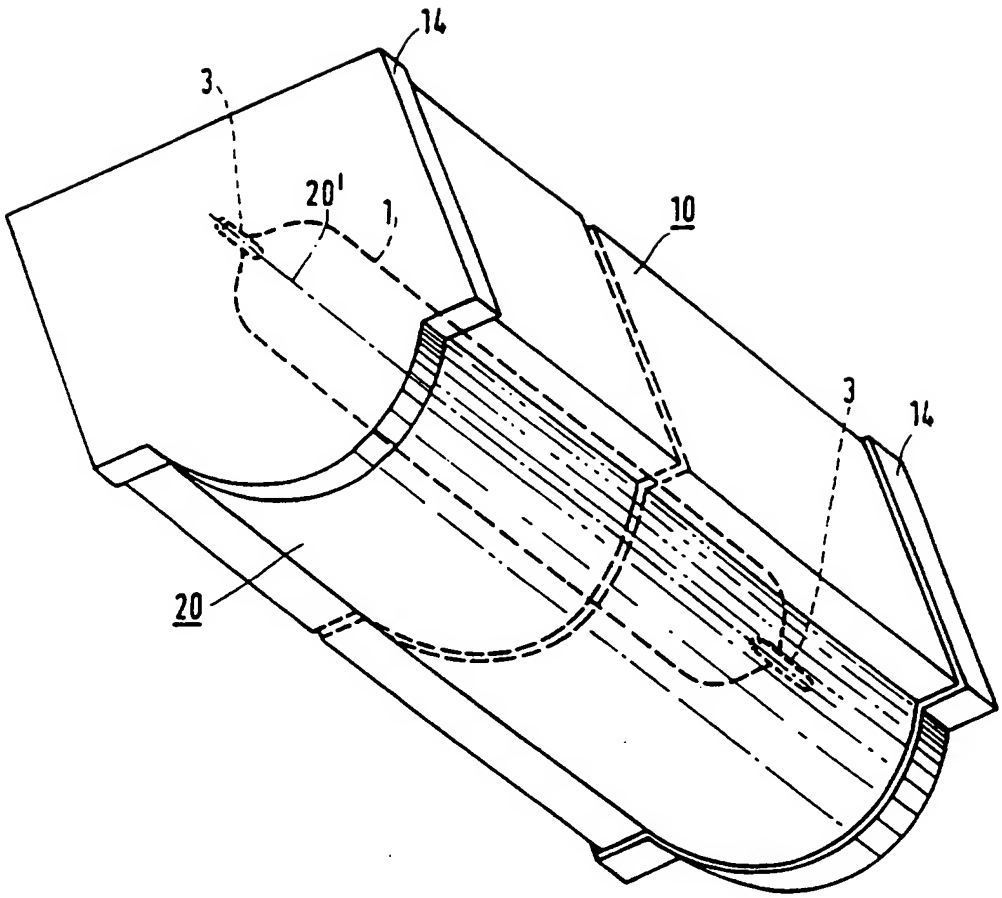

FIG.1

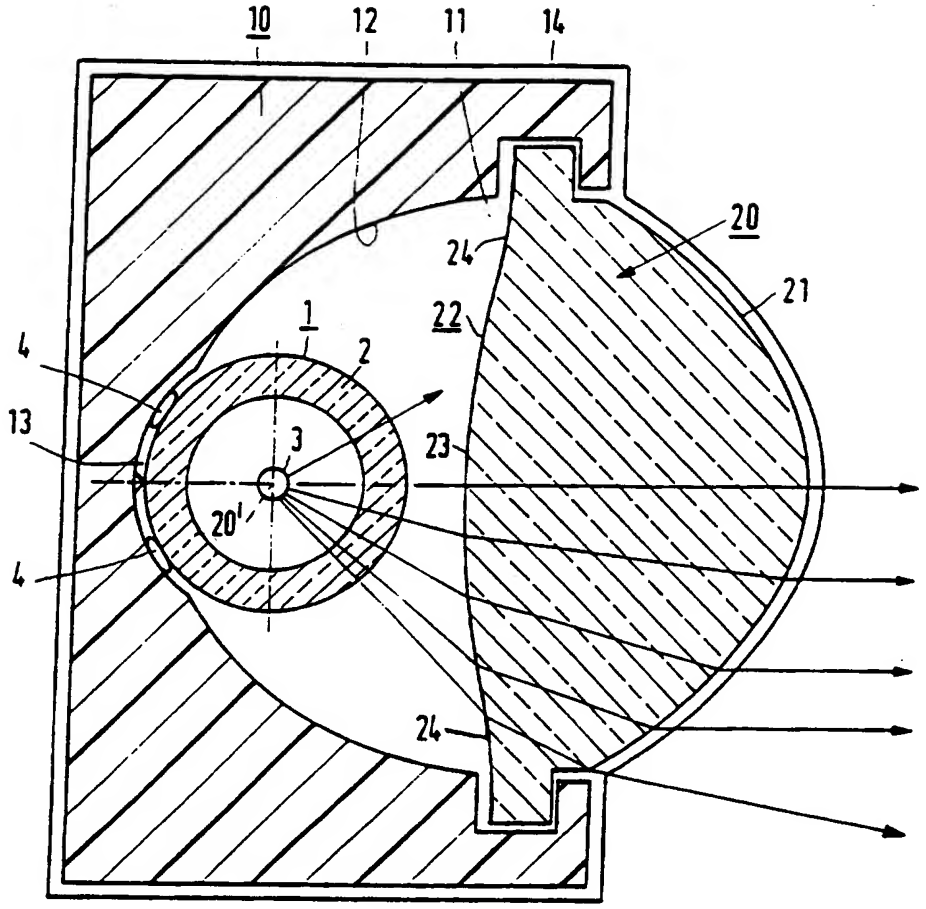

FIG.2

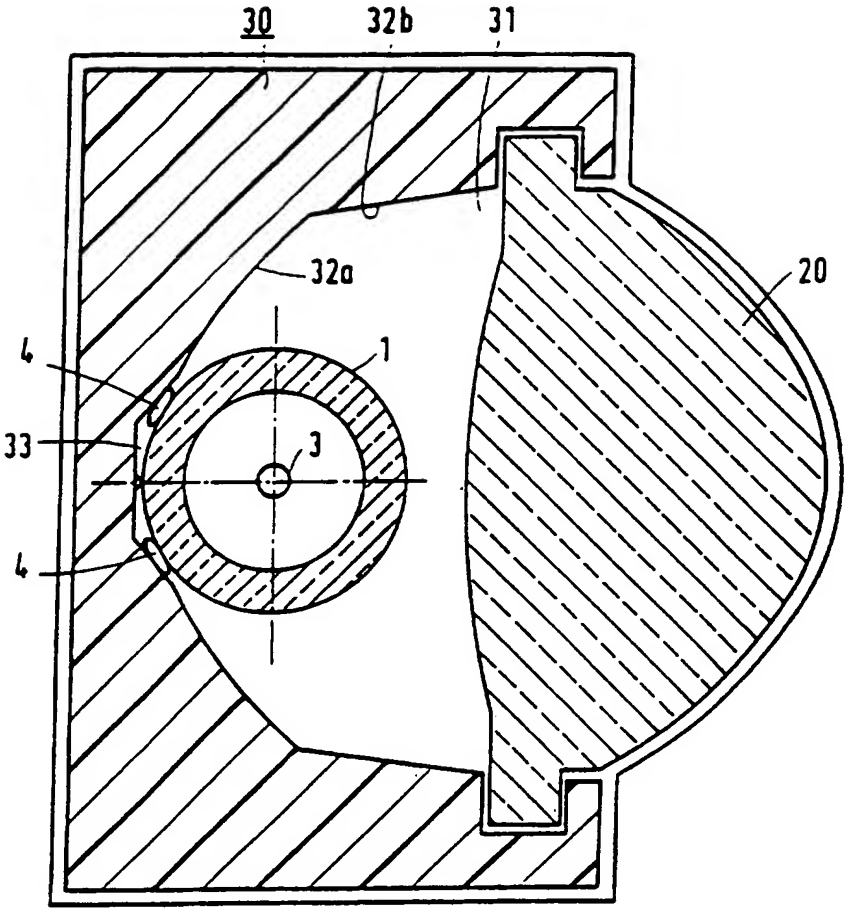

FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 95/00825

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F21Q 1/00, B60Q 1/44
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F21Q, B60Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

ORBIT: WPAT, USPM

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4682146 A (HARRY FRIEDMAN, III), 21 July 1987 (21.07.87) --	1-9
A	WO 9414632 A1 (HUGHES AIRCRAFT COMPANY), 7 July 1994 (07.07.94) --	1-9
E,A	EP 0678702 A1 (SEIMA ITALIANA SPA), 25 October 1995 (25.10.95) --	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

05/02/96

International application No.
PCT/IB 95/00825

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4682146	21/07/87	US-A- 4818968	04/04/89
WO-A1- 9414632	07/07/94	NONE	
EP-A1- 0678702	25/10/95	NONE	